FLOATING BODIES IN JOINTS.

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BY floating bodies in joints, or, as they are frequently termed, joint mice, we mean bodies of varying structure usually composed of bone, cartilage, masses of fibrin or fat, or fibrous tissue which are either loose in the joint or are attached to some part of the joint surface by pedicles. By far the greater part of these bodies is found in the knee-joint, so that when we speak of joint bodies we usually refer to the knee as the seat of disease. They next in frequency are found in the elbow-joint, and rarely in the ankle and wrist. The explanation of their frequent occurrence in the knee-joint is that the joint has a very large surface, and that by its position it is greatly exposed to traumatism.

The first systematic study of these bodies was made about 250 years ago by Pechlin, a Swedish surgeon. Since then numerous cases have been reported and a great many theories advanced in explanation of their origin. Of late years, careful microscopical examination of specimens removed by operation, and found on post mortem, has done much to clear up doubtful points in the etiology of these peculiar bodies.

As an introduction to this paper, I will report three cases which have lately come under my observation.

CASE I.—Mrs. E. J. S., married, aged fifty years. In January, 1893, suddenly (while walking about the house) was seized with a sharp pain in left knee, which was so severe that she fell at once to the floor. The knee immediately became swollen and remained fixed in one position until seen by me the same evening. While examining the knee something seemed to give way; immediately afterwards the joint could be moved. The symptoms of an acute serous synovitis, which was treated by application of cast, presented for about three weeks, when they disappeared. During the following two years she had four similar attacks, the only difference being that the initial symptoms were not so marked. There was no history of trauma, nor of an antecedent joint-disease, and no evidence of chronic rheumatic arthritis.

Examination of the joint made from time to time showed the knee slightly swollen, passive movements limited, and slight crepitation. To the inside of patella could be felt a hard body that was movable over a limited portion of joint. Palpation of this body caused severe pain.

Diagnosis.—Floating cartilages in the knee-joint. Operation March 21, 1895. Under ether anæsthesia an incision to the inside of patella, three inches in length, was made through the skin, subcutaneous tissue, and capsule. During the operation the body felt to the inside of the patella slipped away. On opening and exploring the joint three floating cartilages about the size and shape of small olives were found and removed. Careful exploration showed the capsule thickened, but no defects were found in the articular ends of the bones. Suture of the capsule with catgut, the skin with silkworm gut, with subsequent antiseptic dressing over which was applied a plaster cast. The dressing was removed at the end of a week, and perfect primary union was found. Recovery followed with perfect use of the joint. Microscopical examination of one of these bodies showed it to be made of successive layers of cartilage and calcareous material, the latter closely resembling bone; no fibrous tissue or remnants of the pedicle could be found.

CASE II.—Fred. B., German, aged forty-nine years. Family history negative. Never had any severe illness. When about eighteen years of age he injured his right knee by striking it with an axe. This accident did not produce any marked symptoms at the time. About six years later he noticed a small movable body to the inner side of the patella. At the time he first noticed the loose body it was about the size of a ten-cent piece. He has been more or less disabled by its presence ever since (for thirty years). At times it would become fixed between the anterior surface of the tibia and the capsule, or underneath the patella, causing locking of the joint. He soon learned how to dislodge it, when the joint would return to its former condition. The patient entered the Post-Graduate Hospital in April of this year for the purpose of having the body removed. Examination showed the right knee to be considerably larger than the left; the thigh- and leg-muscles on that side are considerably atrophied. On measuring the femora the right is found three and three-fourths centimetres longer than the left. To the inner side of the patella there is a large loose body which can be freely moved to any part of the joint. The leg being prepared in the usual way, an incision two inches in length was made to the outer side of and along the patella parallel to the extensor tendon, the loose body was pushed up to this point and removed through this opening. The capsule was subsequently sutured with catgut and the skin with silkworm gut, the usual antiseptic dressing being applied, and the leg encased in a plaster cast. The wound healed by primary union, but the joint remained somewhat stiff. The body when removed measured 1 x $\frac{7}{8}$ x $\frac{3}{5}$ inches, was concavo-convex, the convex side being composed of cartilage which overlapped the concave bony surface. The examination showed the cartilage to be of the hyaline variety and the bone spongy without any fibrous tissue being present.

CASE III.—John O., Dane, aged nineteen years. Admitted to Cook County Hospital May 9, 1891. Patient states that for several months he has had trouble in his right knee. He would suddenly, while walking, be seized with severe pain in the knee, which would occasionally cause him to fall to the ground. Patient unable to speak English, therefore a full history cannot be obtained, but he says that about a year ago he injured the knee.

Operation.—Dr. Fenger. Ether. Rigid antisepsis. A longitudinal incision to the inside of patella, about three inches in length. After exploration a loose body was found on the anterior and external aspect of the joint and removed. On the outer semilunar cartilage a defect was found which corresponded in size to the piece of cartilage removed. Joint was irrigated and drained with rubber drainage-tubes; capsule and skin sutured separately with silk suture. Antiseptic dressing and plaster-of-Paris cast. Prompt recovery, with complete restoration of function. No microscopical examination of specimen made.

Etiology.—The cause of loose bodies in the joints has been a much-disputed question. Of late considerable advance has been made in determining the exact causation of individual cases. In the past, most writers ascribed a common cause for all these bodies, whereas we now know that there are a number of factors concerned in the etiology, and different cases have a variety of modes of origin. Exact clinical histories with careful classification on a histological basis have done much to clear up many mooted points in the etiology of these peculiar bodies. Using Volkmann's general classification, we have (*a*) those that are found in otherwise healthy joints, the disease, if any be present in the joint, being only that occasioned by the presence of these bodies; (*b*) those that are found in diseased joints.

Under the first general head we have the following subdivisions: (1) Those that are purely of traumatic origin. These may be made up of (*a*) cartilage alone; (*b*) bone; (*c*) bone and cartilage combined. Of those that come under this head there are but few. I might say that in a careful review of the literature of the subject, I found only three cases, one of which is doubtful. I do not include in this class the cases of detached semilunar cartilages which are sometimes completely separated by traumatism and act as loose bodies, but only those cases of completely separated pieces of the articular ends of the bones. Experimental researches regarding the production of loose bodies in the joints, especially those of Kragelund, argue decidedly against any parts of the joint-surfaces being separated immediately as the result of traumatism. Kragelund found that in no case could complete separation of a piece of bone or cartilage be produced by violence applied to a dead body; that pieces loosened in this way had to be removed with forceps later in order to entirely free them from their attachments. It is easy to see how pieces of bone or cartilage, or both, might be separated at the point of attachment of the ligaments, but such pieces would not act as loose bodies. König maintains that immediate separation o bone or of cartilage as a result of violence applied to the articular ends of the bones never occurs, and that there are no authentic cases of this kind on record.

O. Volker reports the only case of purely traumatic origin of loose bodies in which the patient survived the injury. His case was that of a soldier who injured himself by stepping into an excavation. The accident was immediately followed by swelling of the knee and complete loss of function. Examination immediately after the injury under chloroform showed the presence of a loose body. An operation was performed a few days later, and blood was found in the joint together with a loose body consisting of bone and cartilage, the osseous side of which showed evidences of being recently split from the articular end of the femur, a corresponding defect being found on the internal condyle.

Fischer reports a case of purely traumatic origin. The patient, a male, was forty years of age, and fell from a distance, sustaining injury, from the result of which he died a few days later. On section, a loose body was found in the right elbow-joint, which corresponded to a defect on the anterior surface of the olecranon. No diagnosis of fracture was made before death.

In Feurer's case, cited by Real, where a young woman had fallen from a stool, striking on the knee, there was immediate swelling and loss of function. Two and a half weeks later a body was found in the joint. Operation showed it to consist of cartilage and bone, the osseous portion having a clearly-defined split surface. Real regards this as a case of immediate separation from trauma, but the time (two and a half weeks) which elapsed after the injury before the body was found would be sufficient to allow of another explanation of its origin. Most of the cases reported by Hasse, Bischet, Hadder, Lany, Real, and others, which are said to be purely traumatic in origin, are open to the same criticism, and do not belong to this class. In order that we may place any individual case in this category, we must have the following conditions:

(1) There must have been sufficient violence to break off a piece of the articular ends of the bones. This, as we have seen, is considerable.

(2) There must be a loose body found immediately after the injury.

(3) The body must correspond in size and general contour to the defect found in the bone at the time of operation.

(4) Microscopical examination of the body must show it to be made of normal cartilage and bone, or of cartilage alone. Unless we have all or most of these conditions present, we are not in a position to assume that the body was the immediate result of violence.

The structure of these loose bodies which originate in this manner corresponds to normal bone and cartilage; in most of them we find both bone and cartilage. If purely cartilaginous, they are of the hyaline variety, and their shape shows them to be pieces separated from the joint-surface. They are never enveloped in a fibrous capsule, but may, as the result of friction or degenerative changes, be materially altered in their form and appearance.

(2) Loose bodies composed of separated pieces of cartilage or of bone that were not broken off at the time of injury, but which became detached later. The pathological condition that leads in this way to the formation of loose bodies, has been carefully studied by König under the name of "osteochondritis desiccans," and then later by Poulet and Villard without their giving it any name. It was also recognized by Paget, who called it "quiet necrosis." Its cause is unknown. All that we know about the disease is that (1) it may follow a traumatism; (2) it may originate spontaneously; (3) it may develop at any period of life; (4) small pieces of the articular ends of bones may be loosened as the result of the disease, causing floating bodies; or the whole articular end of the bone may separate, as occurs sometimes in the hip- and shoulder-joints.

In this paper the consideration of this pathological condition only interests us in so far as the disease bears a causal relation to the presence of loose bodies in the joint; and that it frequently does so is evidenced by two of König's reported cases in which he found incontrovertible evidence of a chronic inflammatory process (infiltration of the round cells, etc.), both in the loose bodies and at the place of separation. In all he reports eight cases of loose bodies, three of the elbow, five of the knee, in only two of which was there a history of trauma. In all defects were found in the bone corresponding with the size and shape of the loose bodies. In none were there any signs of arthritis deformans or of tuberculosis. As previously stated, most of the cases reported, to which trauma was the assigned cause, can only be explained by supposing that the trauma acted indirectly by interfering in some way with the nutrition of the parts, the separation occurring later as the result of this disturbance. In a great many cases there is no history of trauma. In these we know nothing of the cause of the chronic osteitis that determines the separation of pieces of cartilage or bone from the articular surface of the joint. The loose bodies that result from the so-called osteochondritis desiccans are usually made up of cartilage alone or of bone and cartilage combined. They have a more or less circular outline, are generally concavo-convex, the convex side corresponding to the articular surfaces of the joint, and composed of hyaline cartilage. They have been in the joint for some time; they are usually worn smooth and facetted where they have come in contact with the bony parts of the joint. They may be multiple, but are usually few in number, not more than three or four, and are frequently single. It is not necessary that they correspond accurately to the defects in the joint-surfaces, or that there need be defects at all; as these are occasionally completely obliterated by a process of regeneration, the bodies are frequently changed in form by retrogressive metamorphoses. As König has shown, they frequently present evidences of inflammatory process within the joint. Another point mentioned by Poulet and Villard is that the disease is frequently symmetrical, affecting homologous joints. Bowlby reports such a case where two loose bodies, one from each knee, composed of hyaline cartilage, in which the cartilage cells were arranged irregularly, were removed from a boy eighteen years of age. There was no history of injury to the joint, nor any evidences of disease other than a recurring synovitis occasioned by the presence of these bodies. Clutton reports a case similar in every respect to this one. The disease most frequently attacks the knee, but may occur in any joint. König reports three cases of this kind, all occurring in young people, and affecting the elbow-joint. There was no history of injury in any of the cases.

(3) Loose bodies originating from hæmorrhage into a sound joint as the result of a traumatism. Cases coming under this

head are exceedingly rare. The characteristic features of such cases are (1) they follow some time after an injury to a joint where there are evidences of hæmorrhages into the joint. (2) That the symptoms are severe for a time, usually lasting from one to three years, and that they subsequently disappear spontaneously and complete recovery follows. Hunter claimed this to be the most frequent mode of origin of joint bodies; but only three cases are reported.

Gurlt mentions one case the formation of which occurred by a small blood clot becoming impregnated with lime salts. Fischer reports one case where a soldier fell from a horse, striking on the flexed knee. Immediately profuse hæmorrhage into the joint followed. Five months after the injury the patient was suddenly seized with a sharp pain in the knee, with fixation of the joint and inability to straighten or flex the leg. Under chloroform narcosis a large loose body could be felt inside of the patella. The patient refused an operation, and so he suffered for two years with recurring synovitis, and all the while could feel the body in the joint. A year later, or three years after the accident, when Fischer examined him the body had disappeared. Recovery followed. Shattock's case might be placed in this list. He reports a case of pedunculated body 4 x 3 x 7 centimetres, situated underneath the patella of the left knee-joint. The body was removed, and on microscopical examination it was found to be made up of a finely intercommunicating trabeculæ, resembling fibrous tissue, into which was dispersed a fine reddish-brown pigment with some red and white blood-corpuscles. He regards this as an example of an attempt at organization of blood clot. The hæmorrhage evidently took place into the superficial layer of the synovia. Bowlby reported a similar case where a hæmorrhage into the synovial fringe was the cause of a pedunculated floating body.

(4) Loose bodies caused by drawing into the joint of a foreign body embedded in the capsule. Large foreign bodies, such as bullets, may remain in the joint cavity for some time without causing much disturbance and act as nuclei for the formation of loose cartilages, but, as a rule, they cause symptoms

which call for their early removal. If embedded in the capsule or near the articular surfaces of the bones they may stimulate the proliferation of cartilage cells so as to cause enchondroses, which subsequently break off or become pedunculated. This is more frequently the case when the body is small. A case of this kind was observed by Shaw, where an osseous cartilaginous pedunculated body having embedded in its centre the point of a needle one-twelfth of an inch in length was found in the knee-joint of a young woman. The pedicle was attached to one condyle of the femur. The central portion of the body was composed of bone around which was a layer of cartilage, the whole covered with a thin layer of fibrous tissue.

(1) Under the second general heading where loose bodies occur in diseased joints, by far the most frequent are the so-called corpora oryzoidea, which are found in tubercular hydrops articuli and so-called hydrops fibrinosis of Volkmann and Ranke. These are known sometimes to follow trauma, but not usually. They are found in large numbers and originate in one of three ways: (1) As pure concretions. (2) By desquamated epithelium forming nuclei upon which is deposited several layers of fibrin. (3) Sometimes they are simply detached villi, which enlarge by accumulation of successive layers of fibrin, or by swelling and by degenerative changes taking place. The joint capsule in these cases presents the characteristic changes that are found in any similarly diseased joint, —that is, the presence of the bodies does not induce the changes in the joint as in the other cases considered. As a rule, they do not produce the common symptoms of loose bodies in the joint, partly because of their size, and partly for the reason that the underlying pathological condition produces symptoms that obscure those occasioned by loose bodies.

(2) Bodies that originate from cartilaginous metamorphosis of the synovial membrane or of the fibrous layer of the capsule which are subsequently drawn into the joint and remain either attached by a pedicle or become detached, forming free bodies. This is a relatively frequent cause of loose bodies in the joint.

As a rule, they remain attached to the capsule, but are sometimes found free. Laennec in 1813 first described the formation of movable bodies by this process. Volkmann has reported several cases where bodies were found both free and attached to the capsule.

The various stages of their development have been carefully studied by Gurlt in his work on the " Pathological Anatomy of Joint-Disease." In this work are cuts illustrating the origin of these bodies and showing their various stages of development.

Virchow observed a case where two of these bodies were found free in the joint cavity, and three attached by pedicles of varying thicknesses. The pedicles usually become more attenuated and finally are detached, leaving the bodies free in the joint. These bodies are usually biconvex, one side being cartilaginous, the other bony, the cartilage overlapping the bone. In the larger the osseous elements predominate. These are, as a rule, free. The smaller ones are usually pedunculated, the pedicles being devoid of blood-vessels. Cases of loose bodies originating in this way are reported by Klein, Fischer, Delgarde, and Schmidt.

(3) Loose bodies resulting from pathological changes occurring in normal joint villi with subsequent detachment of these villi. Rokitansky was the first to show that degenerated joint villi were a frequent cause of loose bodies in the joints, although the so-called lipoma arborescens was earlier described. Volkmann has shown that in most chronic joint inflammations proliferation of cartilage cells takes place on the swollen ends of the villi, or they become calcified, and are subsequently loosened by being caught between the articular ends of the bones. Rokitansky believes all cartilaginous joint bodies are formed in this way, as the normal villi contain cartilage cells which proliferate, and may or may not be impregnated with lime salts. Fischer thinks this theory explains a few, but not all, of the cartilaginous bodies found in joints. Those that are composed of hyaline cartilage with or without calcification, and that have no fibrous capsules and no remnants of a pedicle, he regards as formed in this way. These, as before mentioned, are usually associated with a chronic inflammation of the joint, and are usually multiple, and are, as a rule, reniform in shape and very elastic.

Simon observed a case of sarcoma of a villus which had become detached and formed a loose body.

(4) Loose bodies that occur in arthritis deformans. These are not common. Recklinghausen in 1865 reported a case. They are usually composed of bone, being more or less covered with cartilage and of irregular shape and uneven surface. The characteristic condition found in other joints in this disease will be sufficient upon which to base a diagnosis.

The question of the growth of these bodies that are free in the joint is of some interest. Cases are recorded where the growth during the course of years has been noticed both by the patient and the surgeon. In one of my cases (Case II), the patient, an intelligent man, says that he first noticed a movable body in his knee, which was smaller than when removed. It is generally conceded that they sometimes grow, but the exact way in which they grow is still not clearly understood. Virchow thinks that it is possible for them to increase in size in two ways: (1) by deposition of successive layers of fibrin; (2) by proliferation of cartilage or bone-cells that are originally present in the body, the nourishment being supplied by the synovia. The latter is the way in which pedunculated bodies, as well as free bodies, grow. The fact that the pedicle never contains any blood-vessels shows that the nourishment must be derived from the synovial fluid. Poncet mentions that the increase in size is due to degenerative changes, a proposition that is not sustained by any other evidence.

Symptoms.—As a rule, disturbances produced by loose bodies in a joint are sufficiently prominent to enable an early positive diagnosis to be made. The first and most prominent symptom of loose bodies in the knee is a sudden locking of the joint, usually in the position of nearly complete extension, and it may remain in this position for several days, any attempt to change it causing severe pain. The cause of this is the presence of the body between the anterior surface of the bones and the capsular ligament.

But immediately following this we have an acute synovitis which lasts from one to four weeks. These symptoms recur at longer or shorter intervals. Usually there are three or four attacks during the course of a year.

On careful examination there will be found a loose body in the joint, frequently on the inner side of the patella. In the elbow-joint a recurring synovitis with inability to completely straighten the arm are the most prominent symptoms. In these cases the body usually lies on the anterior surface of the joint, between the capsule and the surfaces of the articular ends of the bone. Limitation of motion is present in all cases. Crepitation is usually present and is caused by a thickening of the capsule. Lengthening of the femur on the side of the affected joint has been tested. This was found in two of Real's cases and in one of my own. In all the tibia and fibula were of equal length in the two limbs, and the bones were otherwise normal. There are no other observations on this point recorded. In one of Real's cases a lengthening of two centimetres is recorded, in the other one and a half centimetres. In my case there was present a lengthening of fully three centimetres.

The cause of increased development of the bones has been carefully studied by Poncet and Bidder. We know that an inflammatory condition of the periosteum or of the bone itself, or any inflammation in close proximity to the bone, will stimulate the growth of bones both in thickness and length, when inflammation is present during the growing period of life. Clinically this has been frequently observed. Langenbeck reports a case of lengthening of the femur of two centimetres which occurred within two months. As previously stated, this is the only course that the disease takes on before the bones are fully developed. In young individuals any inflammatory disease of the epiphyses will limit the growth, while if the shaft be the seat of the disease increase in length will occur. Inflammation in one bone may also cause an increase in length of the neighboring bones. Langenbeck mentions a case where the tibia was the seat of osteomyelitis in which an increase of three centimetres in the femur of the corresponding side was noted. The same occurrence has been observed where the radius was the seat of osteomyelitis causing an increase in length of the ulna on the corresponding side.

The case of Broca, cited by Langenbeck, where an aneurism of the femoral artery stimulated the growth of the femur, proves that an irritant, not necessarily of an inflammatory nature, may cause an increase in length of the long bones. The cause of lengthening where floating bodies are present may be explained by the irritation of the articular ends of the bones, caused by the presence of these foreign bodies. This can only take place when the body is in a joint during the growing period of life. In my case the body was present for thirty years.

Diagnosis.—The diagnosis, when the previously-mentioned symptoms are considered, is usually very easily made. The body is frequently felt by the patient himself, who makes the diagnosis before consulting a physician. The sudden occurrence of pain in a joint otherwise healthy, with fixation in some position, or the sudden onset of an acute synovitis with no other apparent cause, will be sufficient ground upon which to make a probable diagnosis. The finding of the movable body in the joint generally makes the diagnosis positive, although in a few cases the body is never felt during the examination.

Treatment.—It may be of historical interest to mention some of the methods of treatment that were employed in pre-antiseptic days. Chassaignac mentions the following methods that were employed:

(1) *Palliative.*—(*a*) Fixation of the loose body by compression, so that it may become attached to the capsule; (*b*) fixation by passing needles through a part of the capsule; and (*c*) fixation by subcutaneous ligature.

(2) *Radical Methods.*—(*a*) Removal through direct incision; (*b*) incising the skin and capsule at different levels; (*c*) through subcutaneous operations performed at two sittings, the skin from a distance being displaced over the body; incision made through the skin and capsule, the body allowed to escape into the subcutaneous incision, from which it was removed at a later time after the capsule had healed.

During the pre-antiseptic period the mortality connected with these radical methods of treatment was very high. Bell recommended amputation in those cases where an operation was indicated, in preference to opening the knee-joint. The mortality at this time was about 33 per cent., and of those who escaped with their lives a great number went through life with a more or less ankylosed joint, as a result of septic infection. It is scarcely worth while to mention that the only method of treatment of to-day is to remove these bodies by direct incision. The limb should be carefully prepared twenty-four hours before the operation, and covered with a wet antiseptic dressing. The operation should be performed either with the patient under the influence of a general anæsthetic, or preferably by the use of local anæsthesia. In one of the cases that I have reported, the operation was performed without the slightest discomfort to the patient with Schleich's method of cocaine anæsthesia (.02 per cent. solution). The advantage of this method is that the patient can assist in finding the body in case it should escape during the operation, and there is absolutely no danger connected with the use of cocaine when employed in this way. After the loose body or bodies have been removed, the joint capsule should be sutured with fine catgut and the skin with silkworm gut. No drainage or irrigation should be employed. The mortality should be *nil*, and if septic infection is prevented, which is possible in every case, there is absolutely no damage done to the joint by the operation. Healing is usually complete at the end of a week, when the patient should be able to walk without any pain or stiffness of the joint.

REMARKS ON THE REPORTED CASES.

In Case I there is nothing unusual. It presents the features common to most of those of the class to which it belongs. Without doubt, these bodies originated from changed and subsequently loosened joint villi. That this was the way in which these bodies originated is evidenced by the following:

(1) The shape of the body. Three were similar in size and shape, all about as large as small olives.

(2) Structure. They were composed of hyaline cartilage, arranged in concentric layers, the centre and intermediate substance being calcareous deposit.

(3) The chronic inflammatory condition of the joint, which is shown to have existed for some time by the thickening of the capsule. We know that usually, when detached villi are the cause of loose bodies, the joint is the seat of a chronic inflammation.

(4) No defects were found in the articular surfaces of the bones.

Cases II and III represent that class that originates by separation of pieces of the articular cartilage, or of the cartilage and bone, the result of the so-called osteochondritis desiccans, the trauma occurring some time before the pieces separate. In Case II no defect was found in the joint surface, but, as mentioned in Case III, a small defect was found on the outer margin of the semilunar cartilage, corresponding in size and shape to the loose body.

CONCLUSIONS.

(1) That the etiology of some of these bodies is yet not fully understood; but that the condition described by König under the name of osteochondritis desiccans explains the most of those that are found in otherwise normal joints. This deserves further investigation.

(2) That few, if any, are the direct result of violence.

(3) That the most pronounced symptom is the sudden onset of severe pain in the joint with locking of the joint, usually in a nearly extended position, this being followed by acute inflammatory process in the joint involved.

(4) That lengthening of femur (in movable bodies in knee) may occur as a result of irritation produced by the pressure of these bodies.

(5) That the only treatment for this condition is the removal by direct incision, preferably under cocaine anæsthesia, as soon as diagnosis is made.

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